

A YAW, PITCH AND ROLL APPARATUS FOR A MULTIPLE UNIT VEHICLE

Field of the Invention

This invention relates to articulated vehicles and more particularly to an apparatus permitting pitch, yaw and roll interrelationship between multiple vehicle units.

Background of the Invention

Articulated vehicles with apparatus permitting yaw, pitch and roll interconnections are known in the arts including U.S. Patent No. 4,545,454 to Bas; U.S. Patent No. 5,366,299 to Hughes; U.S. Patent No. 4,482,165 to Dawson et al; and U.S. Patent No. 5,456,185 to Rother et al.. The patents referred to herein are provided herewith in an Information Disclosure Statement in accordance with 37 CFR 1.97.

Summary of the Invention

The present invention is an apparatus creating yaw, pitch and roll interconnections between vehicles in a multiple unit vehicle. Pitch is provided by a hinge connection with one hinge first leaf affixed, generally by an immovable affixing means including welding, bolting, riveting and other such immovable means to a first vehicle unit. The first leaf is connected to a second leaf by hinge means provided in the preferred embodiment as a shaft received by outwardly extending planar elements, presenting apertures, extending from each of the first leaf and the second leaf thereby permitting shaft interconnection of the first leaf and the second leaf allowing the first leaf and the second leaf to revolve relative to the other. The orientation of the first and second hinged leaves, comprising the pitch assembly, is such as to respond with pitch movement, between the first and the second vehicle when the vehicle is subject to a pitch position as it transits terrain.

A roll assembly comprised of roll means and provided, in the preferred embodiment, of a threaded unit received by a complementary threaded unit. Those of ordinary skill in the mechanical arts will recognize that other threaded configurations

1 will provide an equivalent function. The complementary threaded unit, either male or  
2 female, depending on the form of the threaded unit, is affixed by means to a second  
3 vehicle. Such affixing means includes but is not limited to welding, bolting, riveting  
4 and other such immovable affixing means. The threaded unit is affixed to a threaded  
5 unit plate again by such similar affixing means. The roll assembly is interconnected  
6 to the second vehicle unit in an orientation to allow roll movement between the first  
7 vehicle unit and the second vehicle unit when the multi-unit vehicle traverses terrain  
8 imposing roll forces of the first vehicle unit relative to the second vehicle unit. The  
9 threaded unit plate of the roll assembly and the second leaf of the pitch assembly are  
10 interconnected by the yaw assembly.

11 The yaw assembly is comprised of at least one plate extending from the  
12 second leaf to present an aperture for alignment with at least one plate extending  
13 from the threaded unit plate which presents an aperture for alignment with said  
14 apertures receiving shaft joining means. The orientation of the yaw assembly plates  
15 is such as to allow yaw movement between the first vehicle unit and the second  
16 vehicle unit when the first vehicle unit yaw turns relative to the second vehicle unit.  
17 The aligned apertures receive either rotatable shaft means and or yaw motor means.  
18 A yaw motor, comprised in the preferred embodiment of an electric, pneumatic or  
19 hydraulic motor, is immovably affixed to either the plate extending from the second  
20 leaf or the plate extending from the threaded unit plate with a shaft and key-notch  
21 interconnecting with the opposing plate so as to exert yaw forces on the respective  
22 second leaf and threaded unit plate thereby creating a turning force vis-a-vis the first  
23 and the second units. A vehicle steering means will provide electric, pneumatic and  
24 or hydraulic signals or forces at the yaw motor means causing the exertion of yaw  
25 power.

26

## 27 Brief Description of the Drawings

28 The foregoing and other features and advantages of the present invention will  
29 become more readily appreciated as the same become better understood by reference  
30 to the following detailed description of the preferred embodiment of the invention  
when taken in conjunction with the accompanying drawings, wherein:



1 (130) allowing a pitch relationship between the first vehicle unit (10) and a second  
2 vehicle unit (20). Pitch assembly interconnection means to a first vehicle unit  
3 comprised of affixing means including welding, nut and bolt, rivet and other  
4 equivalent means. The pitch assembly interconnection means to a first vehicle unit  
5 (10) is comprised of a first hinge leaf or first pitch interconnection plate (110) affixed  
6 by interconnection affixing means to the first vehicle unit (10). The first pitch  
7 interconnection plate (110) is pitch rotatably affixed by pitch interconnection affixing  
8 means (130) to a pitch assembly attachment plate (120) or a second hinge leaf. The  
9 first pitch interconnection plate (110) is affixed to the first vehicle unit (10) in an  
10 orientation to permit pitch movement between the first vehicle unit (10) and the  
11 second vehicle unit (20). The pitch assembly attachment plate (120) is immovably  
12 connected, by affixing means, to at least one first yaw assembly plate (210) thereby  
13 providing interconnection between the pitch assembly (100) and the yaw assembly  
14 (200). Immovable affixing means includes welding, bolting, riveting and other  
15 equivalent affixing means. The pitch-yaw assembly interconnection means of the  
16 pitch assembly (100) and the yaw assembly (200) rotatably interconnects the pitch  
17 assembly (100) with the yaw assembly (200). The pitch assembly attachment plate  
18 (120) has an assembly plate first side (122), an assembly plate second side (123), an  
19 assembly plate top (126) and an assembly plate bottom (127).

20 The first pitch interconnection plate (110) is affixed by rotatable pitch  
21 interconnection affixing means (130) to the pitch assembly attachment plate (120) at  
22 the assembly plate front side (124) proximal the assembly plate bottom (127) or at the  
23 assembly plate bottom (127). The first pitch interconnection plate (110) is affixed by  
24 rotatable pitch interconnection affixing means (130) to the assembly plate first side  
25 (122) intermediate the assembly plate top (126) and the assembly plate bottom (127)  
26 or proximal the assembly plate bottom (127). The rotatable pitch interconnection  
27 affixing means (130), in the preferred embodiment, is comprised of hinge means  
28 (130).

## 29 **YAW ASSEMBLY**

30 The yaw assembly (200) has yaw means and the said yaw assembly (200) has  
pitch-yaw assembly interconnection means of the pitch assembly (100) and the yaw

1 assembly (200). The yaw assembly (200) has yaw-roll assembly interconnection  
2 means and yaw means which allows a yaw relationship between the first vehicle unit  
3 (10) and the second vehicle unit (20). The at least one first yaw assembly plate (210)  
4 has a first yaw assembly plate edge (212), an extension edge (213), a first yaw  
5 assembly plate top (214) and a first yaw assembly plate bottom (215). The at least  
6 one first yaw assembly plate edge (212) is immovably affixed by edge affixing means  
7 at the assembly plate second side (123). Immovable affixing means includes  
8 welding, bolt and nut, rivet and other such affixing means. The extension edge (213)  
9 is distal from the first yaw assembly plate edge (212) and the at least first yaw  
10 assembly plate (210) extends from the assembly plate second side (123) outwardly  
11 from the assembly plate second side (123). The at least one second yaw assembly  
12 plate (220) has a second yaw assembly plate edge (222), a second extension edge  
13 (223), a second yaw assembly plate top (224) and a second yaw assembly plate  
14 bottom (225). The at least one second yaw assembly plate edge is immovably  
15 affixed by edge affixing means at the yaw-roll interface plate (310) at a yaw surface  
16 (314). The second extension edge (223) is distal from the at least second yaw  
17 assembly plate edge (222). The at least second yaw assembly plate (220) extends  
18 from the yaw surface (314) outwardly from the yaw surface (314). The yaw-roll  
19 interface plate (310) has a yaw-roll interface plate top (311) and a yaw-roll interface  
20 plate bottom (312). Yaw interconnection means interconnects the at least one first  
21 yaw assembly plate (210) and the at least one second yaw assembly plate (220)  
22 proximal the respective extension edge (213) and second extension edge (223). Yaw  
23 interconnection means receives yaw power means to urge the at least one first yaw  
24 assembly plate (210) to yaw rotate with respect to the at least one second assembly  
25 plate (220).

26 In the preferred embodiment, the first yaw assembly plate edge (212) is  
27 immovably affixed by edge affixing means at the assembly plate second side (123)  
28 intermediate the assembly plate top (126) and the assembly plate bottom (127) or  
29 proximal the assembly plate bottom (127). Yaw interconnection means which  
30 interconnects the at least one first yaw assembly plate (210) and the at least one  
second yaw assembly plate (220) is proximal the respective extension edge (213) and

1 second extension edge (223) and is comprised of at least one first aperture (217),  
2 from the first yaw assembly plate top (214) to the first yaw assembly plate bottom  
3 (215), proximal the at least one first yaw assembly plate extension edge (213), and at  
4 least one second aperture (227) from the second yaw assembly plate top (224) to the  
5 second yaw assembly plate bottom (225), proximal the second extension edge (223)  
6 wherein said at least one first aperture (217) and said at least one second aperture  
7 (227) are aligned to receive rotatable shaft or shaft interrelated with gear  
8 interconnecting means. Said shaft or shaft interrelated with gear interconnecting  
9 means receives yaw power means to urge the rotation of the at least one first yaw  
10 assembly plate (210) relative to the at least one second yaw assembly plate (220).

11 Rotatable yaw power means is comprised of a motor means (400) driving a  
12 motor shaft (410). The motor means (400) is stationarily fixed by stationary fixing  
13 means at either the first yaw assembly plate top (214), the first yaw assembly plate  
14 bottom (215), the second yaw assembly plate top (224) or the second yaw assembly  
15 plate bottom (225); where the motor means (400) is affixed. Stationary fixing means  
16 includes bolt/nut, welding, riveting and such other equivalent means. In the preferred  
17 embodiment the motor means is affixed by motor mounting means to the at least one  
18 second yaw assembly plate (220) such that the motor shaft (410), either directly or by  
19 gear means torque connected to the shaft or shaft interrelated with gear  
20 interconnection means, key notch means or gear means is interconnected to the at  
21 least one first yaw assembly plate (210) thereby causing yaw power to be exerted to  
22 cause the at least one second yaw assembly plate (220) to yaw rotate relative to the at  
23 least one first yaw assembly plate (210). Stationary fixing means and motor mount  
24 means includes bolt/nut, welding, riveting and such other equivalent means.

25 The motor means (400) yaw power to the shaft (410) is key (420) and notch  
26 (425) interrelated or the shaft (410) is interrelated with gear means (430)  
27 interconnection at the at least one first aperture (217) or at the at least one second  
28 aperture (227) to urges the respective at least one first yaw assembly plate (210) to  
29 yaw rotate relative to the at least one second yaw assembly plate (220) responsive to  
30 power means signals received by the motor means (400) at signal input means (440).  
In the embodiments of this invention motor means (400), as will be appreciated by

1 those of ordinary skills, are comprised of electric, pneumatic or hydraulic motors with  
2 operating signals or forces transmitted by steering means. Those of ordinary skills in  
3 motor arts will appreciate that electric signals or pneumatic or hydraulic forces are  
4 transmitted by known structures from the turning or operations of a steering means.

## 5 **ROLL ASSEMBLY**

6 A roll assembly (300) has roll means. The roll assembly (300) has yaw-roll  
7 assembly interconnection means of the yaw assembly (200 )and the roll assembly  
8 (300) and has roll interconnection means to the second vehicle unit(20). The roll  
9 means allows a roll relationship between the first vehicle unit (10) and the second  
10 vehicle unit (20). The roll assembly (300) has a yaw-roll interface plate (310); the  
11 yaw-roll interface plate (310) is fixedly connected, by plate affixing means, to at least  
12 one second yaw assembly plate (220). The yaw-roll assembly interconnection means  
13 yaw rotatably interconnects the yaw assembly (200) with the roll assembly (300).  
14 The yaw-roll interface plate (310) is interconnected by roll means with a second roll  
15 interconnection plate (320). The second roll interconnection plate (320) is affixed by  
16 immovable plate affixing means to the second vehicle unit (20). Roll means is  
17 comprised of first roll interconnecting means (330) received by second roll  
18 interconnecting means (340). In the embodiments of this invention, the first roll  
19 interconnecting means (330) is comprised of threaded means received by second roll  
20 interconnecting means (340) which are comprised of complementary receiving  
21 threaded means, i.e., as will be appreciated by those of ordinary skills, where the first  
22 roll interconnecting means (330) is a male threaded element, the second roll  
23 interconnecting means (340) will be a female threaded element.

24 The first roll interconnecting means (330), in the embodiments of this  
25 invention, is comprised of threaded means received by second roll interconnecting  
26 means (340) comprised of complementary receiving threaded means. The first roll  
27 interconnecting means (330) is immovably affixed to second roll interconnection  
28 plate (320) at a roll side (321). Immovable affixing means includes welding, nut and  
29 bolt, riveting and such. The second roll interconnection plate (320) is affixed by  
30 means to the second vehicle (20) at a roll-vehicle side (322).

The first pitch interconnection plate (110), the pitch assembly attachment

1 plate (120), the at least one first yaw assembly plate(210), the at least one second yaw  
2 assembly plate (220), the yaw-roll interface plate (310), and the second roll  
3 interconnection plate (320) are substantially planar and will generally be constructed  
4 of a rigid material with strength sufficient to withstand yaw, pitch and roll stresses  
5 imposed as a multi-unit vehicle is in transit. The material will generally be metal  
6 including but not limited to steel plate.

## 9 **AN ALTERNATIVE EMBODIMENT**

10 In an alternative embodiment the at least one first yaw assembly plate (210)  
11 comprised of at least at least one first yaw assembly plate(210) and at least one first  
12 top assembly plate (211). The at least one first yaw assembly plate (210) has a first  
13 yaw assembly plate edge (212), an extension edge (213), a first yaw assembly plate  
14 top (214) and a first yaw assembly plate bottom (215); the at least one first yaw  
15 assembly plate edge (212) immovably affixed by edge affixing means at the assembly  
16 plate second side (123). The extension edge (213) is distal from the first yaw  
17 assembly plate edge (212). The at least first yaw assembly plate (210) extends from  
18 the assembly plate second side (123) outwardly from the assembly plate second side  
19 (123).

20 The at least one top yaw assembly plate (211) has a first yaw assembly plate  
21 edge (232), an extension edge (233), a top yaw assembly plate top (234) and a top  
22 yaw assembly plate bottom (235); the at least one top yaw assembly plate edge (232)  
23 immovably affixed by edge affixing means at the assembly plate second side (123).  
24 The extension edge (233) is distal from the top yaw assembly plate edge (232). The  
25 at least one top yaw assembly plate (211) extends from the assembly plate second  
26 side (123) outwardly from the assembly plate second side (123).

27 The pitch assembly attachment plate (120) is immovably connected, by  
28 immovable affixing means, to the at least one first yaw assembly plate (210) proximal  
29 the assembly plate bottom (127) and the at least one first top assembly plate (211)  
30 proximal the assembly plate top (126).

The at least one second yaw assembly plate (220) is comprised of at least at



1 least one second yaw assembly plate (220) and at least one second top assembly plate  
2 (221). The at least one second yaw assembly plate (220) has a second yaw assembly  
3 plate edge (222), an extension edge (223), a second yaw assembly plate top (224)  
4 and a second yaw assembly plate bottom (225). The at least one second yaw  
5 assembly plate edge (222) is immovably affixed by edge affixing means at the yaw-  
6 roll interface plate (310) at the yaw surface (314). The extension edge (223) is distal  
7 from the second yaw assembly plate edge (222). The at least second yaw assembly  
8 plate (211) extends from the yaw-roll interface plate (310) outwardly from the yaw-  
9 roll interface plate (310).

10 The at least one second top assembly plate (221) has a second top yaw  
11 assembly plate edge (242), an extension edge (243), a second yaw top assembly plate  
12 top (244) and a second yaw top assembly plate bottom (245). The at least one  
13 second yaw top assembly plate edge (242) is immovably affixed by edge affixing  
14 means at the yaw-roll interface plate (310) at the yaw surface (314). The extension  
15 edge (243) is distal from the second top assembly plate edge (242) and the at least  
16 second top yaw assembly plate (221) extends from the yaw-roll interface plate (310)  
17 outwardly from the yaw-roll interface plate (310).

18 The at least one second yaw assembly plate (220) is immovably affixed by  
19 immovable affixing means, at the yaw-roll interface plate (310) at the yaw surface  
20 (314) proximal the yaw-roll interface plate bottom (312) and the at least one second  
21 top assembly plate (221) is immovably affixed by immovable affixing means at the  
22 yaw-roll interface plate (310) at the yaw surface (314) proximal the yaw-roll interface  
23 plate top (311).

24 Yaw interconnection means interconnecting the at least one first yaw  
25 assembly plate (210) and the at least one second yaw assembly plate (220) by aligned  
26 apertures, proximal the extension edges (213) and (233), receiving shaft  
27 interconnection means (500) or yaw power by motor means (400) and motor shaft  
28 means (410) or motor shaft means (410) with gear means (430). Yaw  
29 interconnection means interconnects the at least one top yaw assembly plate (211)  
30 and the at least one second top yaw assembly plate (221) by aligned apertures,  
proximal the extension edges (233) and (243), receiving shaft interconnection means

1 (500) or yaw power by motor means (400) and motor shaft means (410) or motor  
2 shaft means (410) with gear means (430). Rotatable yaw power means comprised of  
3 a motor (400) driving a motor shaft (410); the motor (400) stationarily fixed by  
4 stationary fixing means at either the first yaw assembly plate top (214), the first yaw  
5 assembly plate bottom (215), the second yaw assembly plate top (224) or the second  
6 yaw assembly plate bottom (225); the motor shaft (410) either directly or by gear  
7 means (430) torque connected to the shaft (410) or shaft interrelated with gear  
8 interconnection.

9 In the embodiments of this invention shaft interconnection means (500) may  
10 be comprised, but is not limited to, nut and bolt (500) connection means. Yaw power  
11 by motor means (400) is comprised of electric, pneumatic or hydraulic motor means  
12 with shaft (410), key (420) and notch (425) or shaft (410) and gear (430) drive means.  
13 The first pitch interconnection plate (110), the pitch assembly attachment plate (120),  
14 the at least one first yaw assembly plate(210), the at least one top yaw assembly plate  
15 (211), the at least one second yaw assembly plate (220), the at least one top second  
16 yaw assembly plate (221) the yaw-roll interface plate (310), and the second roll  
17 interconnection plate (320) are substantially planar.

18 While a preferred embodiment of the present invention has been shown and  
19 described, it will be apparent to those skilled in the art that many changes and  
20 modifications may be made without departing from the invention in its broader  
21 aspects. The appended claims are therefore intended to cover all such changes and  
22 modifications as fall within the true spirit and scope of the invention.

23  
24  
25  
26  
27  
28  
29  
30